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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]In this invention, it is related with a laminated ceramic electronic component and a trimming method for the same.

Therefore, it is especially related, for example with the trimming method for a laminated ceramic capacitor, the laminated ceramic electronic component which forms the capacity component like an LC composite part, and its capacity adjustment.

[0002]

[Description of the Prior Art]For example, in a laminated ceramic capacitor, since a laminated ceramic capacitor is completed, trimming for fine adjustment of electric capacity may be performed. As a laminated ceramic capacitor suitable for such trimming, the thing of the structure shown in drawing 3 or drawing 4 is proposed.

[0003]The laminated ceramic capacitors 1 and 2 shown in drawing 3 and drawing 4 are provided with the ceramic layered product 6 which both has two or more pairs of internal electrodes 4 and 5 formed over the specific interface of two or more ceramic layers 3 and the ceramic layer 3 like a well-known laminated ceramic capacitor. The internal electrodes 4 and 5 which make each set make each field counter mutually, and form capacity. The outer terminal electrodes 7 and 8 are formed in each end of the ceramic layered product 6. One internal electrode 4 is connected to the outer terminal electrode 7 among the internal electrodes 4 and 5 which make an above-mentioned each set, and the internal electrode 5 of another side is connected to the outer terminal electrode 8. Thus, with the outer terminal electrodes 7 and 8, the capacity formed between the internal electrode 4 which makes each set, and 5, respectively is taken out outside, while multiple connection is carried out.

[0004]If it is in the laminated ceramic capacitor 1 shown in drawing 3 in the laminated ceramic capacitors 1 and 2 of such a structure in order to make trimming possible, The exterior electrodes 9 for trimmings are formed on the outside surface of the ceramic layered product 6, it is an inside of the ceramic layered product 6, and the internal electrodes 10 and 11 for trimmings are formed in the state where each edge was made to counter mutually, over the specific interface of the ceramic layer 3. The internal electrodes 10 and 11 for trimmings are connected to the outer terminal electrodes 7 and

8, respectively. The internal electrodes 10 and 11 for trimmings make each field counter to the exterior electrodes 9 for trimmings, and form capacity, respectively. These capacity is taken out with the outer terminal electrodes 7 and 8, while a series connection is carried out with the exterior electrodes 9 for trimmings.

[0005]In order to carry out trimming so that it may be considered as the value of a request of the capacity as such a whole laminated ceramic capacitor 1, as a dashed line shows drawing 3, at least some exterior electrodes 9 for trimmings are removed. By this, the area which the exterior electrodes 9 for trimmings, the internal electrode 10 for trimmings, and/or 11 counter effectively decreases, the capacity formed by opposite with the exterior electrodes 9 for trimmings and the internal electrodes 10 and 11 for trimmings decreases, and desired capacity value is acquired.

[0006]On the other hand, if it is in the laminated ceramic capacitor 2 shown in drawing 4, on the outside surface of the ceramic layered product 6, the exterior electrodes 12 for trimmings are formed, it is an inside of the ceramic layered product 6, and the internal electrode 13 for trimmings is formed over the specific interface of the ceramic layer 3. The exterior electrodes 12 for trimmings are connected to the outer terminal electrode 8, and the internal electrode 13 for trimmings is connected to the outer terminal electrode 7. The exterior electrodes 12 for trimmings and the internal electrode 13 for trimmings make each field counter mutually, and form capacity, and this capacity is taken out with the outer terminal electrodes 7 and 8.

[0007]In order to carry out trimming so that it may be considered as the value of a request of the capacity as such a whole laminated ceramic capacitor 2, as a dashed line shows drawing 4, at least some exterior electrodes 12 for trimmings are removed. By this, the area which the exterior electrodes 12 for trimmings and the internal electrode 13 for trimmings counter effectively decreases, the capacity formed by opposite with the exterior electrodes 12 for trimmings and the internal electrode 13 for trimmings decreases, and desired capacity value is acquired.

[0008]

[Problem(s) to be Solved by the Invention]The trimming method shown in above-mentioned drawing 3 and drawing 4, respectively, Since it is going to adjust capacity by removing at least some exterior electrodes 9 and 12 for trimmings, respectively, After trimming, the section of the exterior electrodes 9 and 12 for trimmings will be exposed, or the interface of the exterior electrodes 9 and 12 for trimmings and the ceramic layer 3 will be exposed, and reservation of the weatherability in these portions is needed. Therefore, a stable material must be chemically used for the exterior electrodes 9 and 12 for trimmings, or it must deal with plating, a glass coat, etc. on the surface of the exterior electrodes 9 and 12 for trimmings after trimming.

[0009]When it is going to adjust capacity as mentioned above by removing at least some exterior electrodes 9 and 12 for trimmings, If it is not made not to remove from the end of the exterior electrodes 9 and 12 for trimmings one by one, division of the electrodes 9 and 12 for trimmings may arise, and capacity value may decrease sharply. Therefore, it is necessary to recognize correctly the position which should remove the exterior electrodes 9 and 12 for trimmings, and a trimming operation becomes complicated in a trimming process.

[0010]To the exterior electrodes 9 and 12 for trimmings. Although copper or silver is used in many cases, since such metal is comparatively rich in spread nature, The boundary line of the field where

the exterior electrodes 9 and 12 for trimmings were removed by trimming, and the left-behind field does not appear clearly, but some metal which constitutes the exterior electrodes 9 and 12 for trimmings also to the field which must have been removed by trimming may begin to be prolonged. This makes fine adjustment of capacity difficult.

[0011]Then, the purpose of this invention is to provide a laminated ceramic electronic component and a trimming method for the same which can solve the problem mentioned above.

[0012]

[Means for Solving the Problem]This invention is provided with a ceramic layered product which has an inner conductor formed over a specific interface of two or more ceramic layers and a ceramic layer, In order to solve a technical technical problem which it is first turned to a laminated ceramic electronic component of an inner conductor constituted so that a capacity component might therefore be formed in part at least, and was mentioned above, An inner conductor is provided with at least one pair of comparison electrodes arranged in the state where each edge was made to counter mutually, and them so that capacity may be formed in between [ mutual ] to a ceramic layered product. In order to carry out trimming so that capacity formed by the comparison inter-electrode which makes a pair may be decreased, it is characterized by providing a trimming schedule portion in which removing a ceramic layer selectively from the exterior in a field to which a comparison electrode which makes the pair concerned counters was planned.

[0013]As for a trimming schedule portion, in an above-mentioned laminated ceramic electronic component, it is preferred to be provided in relation to each of both sides where a ceramic layered product counters mutually. In a laminated ceramic electronic component concerning this invention, when trimming is already carried out to a trimming schedule portion, a trimming mark which removed a ceramic layer selectively from the exterior in a field to which a comparison electrode which makes a pair counters is formed in a ceramic layered product.

[0014]An inner conductor may be provided with two or more pairs of comparison electrodes in a laminated ceramic electronic component concerning this invention. In this case, as for each edge of a comparison electrode which makes each set, it is preferred to align in a laminating direction of a ceramic layered product. In a laminated ceramic electronic component concerning this invention, an inner conductor may be provided with two or more pairs of internal electrodes which make each field counter mutually and form capacity further so that a laminated ceramic capacitor may be constituted, for example.

[0015]This invention is provided with a ceramic layered product which has an inner conductor formed again over a specific interface of two or more ceramic layers and a ceramic layer, So that it may be constituted so that a capacity component may be formed as an inner conductor should boil a part at least, and an inner conductor may form capacity in between [ mutual ] further, In order to be turned also to a method provided with at least one pair of comparison electrodes arranged in the state where each edge was made to counter mutually of carrying out trimming of the laminated ceramic electronic component and to solve a technical technical problem mentioned above, By removing a ceramic layer selectively from the exterior in a field to which a comparison electrode which makes a pair counters, it is characterized by having a process which carries out trimming so that capacity formed by the comparison inter-electrode which makes the pair concerned may be decreased.

[0016]Even if a portion located outside a portion pinched in a process of removing a ceramic layer mentioned above from the exterior, between the edges where a comparison electrode in a ceramic layer counters is removed, A portion pinched between the edges where a comparison electrode in a ceramic layer counters may be removed, or these both sides may be removed.

[0017]

[Embodiment of the Invention]Although this invention is applicable to the laminated ceramic electronic component at large which forms a capacity component, it performs explanation of the embodiment of this invention to below in relation to a laminated ceramic capacitor. Drawing 1 is a sectional view showing the laminated ceramic capacitor 21 as a laminated ceramic electronic component by one embodiment of this invention.

[0018]The laminated ceramic capacitor 21 like a well-known laminated ceramic capacitor, It has the ceramic layered product 25 which has two or more pairs of internal electrodes 23 and 24 as an inner conductor formed over the specific interface of two or more ceramic layers 22 and the ceramic layer 22 like the laminated ceramic capacitors 1 and 2 shown in drawing 3 and drawing 4. The internal electrodes 23 and 24 which make each set make each field counter mutually, and form capacity. The outer terminal electrodes 26 and 27 are formed in each end of the ceramic layered product 25. One internal electrode 23 is connected to the outer terminal electrode 26 among the internal electrodes 23 and 24 which make an above-mentioned each set, and the internal electrode 24 of another side is connected to the outer terminal electrode 27. Thus, with the outer terminal electrodes 26 and 27, the capacity formed between the internal electrode 23 which makes each set, and 24, respectively is taken out outside, while multiple connection is carried out.

[0019]In order to make trimming possible in the laminated ceramic capacitor 21 of such a structure, It is an inside of the ceramic layered product 25, and is in the state which each edge was made to counter mutually over the specific interface of the ceramic layer 22 which exists outside the position in which the internal electrodes 23 and 24 were formed, and two pairs of comparison electrodes 28 and 29, and 30 and 31 are formed, for example. The comparison electrodes 28 and 30 are connected to one outer terminal electrode 26, and the comparison electrodes 29 and 31 are connected to the outer terminal electrode 27 of another side. By opposite of each edge which was mentioned above, the comparison electrodes 28 and 30 of one way each and the comparison electrodes 29 and 31 of each another side which make a pair form capacity, while it is mutual, and such capacity is taken out with the outer terminal electrodes 26 and 27.

[0020]In order to consider it as the value of a request of the capacity as such a whole laminated ceramic capacitor 21, trimming is carried out so that the capacity which compares with the comparison electrodes 28 and 30 mentioned above, and is formed among the electrodes 29 and 31 may be decreased. The trimming schedule portion 32 in which removing the ceramic layer 22 selectively for the purpose in the field to which it compares with the comparison electrodes 28 and 30 which make a pair to the ceramic layered product 25, and the electrodes 29 and 31 counter it was planned is formed.

[0021]Like this embodiment, as for each edge of the comparison electrodes 28-31 which make each set, when the comparison electrodes 28-31 are formed two or more pairs, it is preferred to align in the laminating direction of the ceramic layered product 25. It can be considered as the shape which either

of the comparison electrodes 28-31 did not rush in into the trimming schedule portion 32, and was ready in the trimming schedule portion 32 as a result by this. Therefore, at the time of trimming, it can prevent removing either of the comparison electrodes 28-31 accidentally, and trimming operation can be made easy.

[0022]In drawing 1, the trimming mark 34 which the trimming mark 33 which removed the ceramic layer 22 selectively from the exterior was shown by the solid line, and removed the ceramic layer 22 selectively from the exterior in another mode is shown by the dashed line in the trimming schedule portion 32 mentioned above. The trimming mark 33 shown as the solid line is formed as a result from which the portion located outside the portion pinched between the edges where the comparison electrodes 28-31 in the ceramic layer 22 counter was removed. On the other hand, the trimming mark 34 shown with the dashed line is formed as a result from which the portion pinched between the edges where the comparison electrodes 28-31 in the ceramic layer 22 counter was removed.

[0023]Although each of these trimming marks 33 and 34 is formed by irradiating with a laser beam, for example, or applying sandblasting from the outside of the ceramic layered product 25, The capacity which compares with the comparison electrodes 28 and 30, and is formed among the electrodes 29 and 31 decreases, and the capacity as the laminated ceramic capacitor 21 whole taken out between the outer terminal electrode 26 and 27 decreases according to this as the depth and width increase. Therefore, trimming operation is carried out until capacity decreases in this way and the capacity as the laminated ceramic capacitor 21 whole reaches a desired value. As an example, when trimming which forms the trimming mark 34 in the laminated ceramic capacitor whose design capacity is 2 pF was carried out, the 0.2-pF capacity drop equivalent to 10% of design capacity was checked.

[0024]Generally, a trimming mode which brings about the trimming mark 33 is suitable, when the span of adjustable range which needs capacity value is comparatively small, and a trimming mode which brings about the trimming mark 34 is suitable when the span of adjustable range which needs capacity value is comparatively large. Therefore, according to the size of the span of adjustable range of the capacity value to need, these trimming mode is used properly. Both trimming mode may be adopted simultaneously.

[0025]Drawing 2 is a sectional view showing the laminated ceramic capacitor 41 as a laminated ceramic electronic component by other embodiments of this invention. Since this laminated ceramic capacitor 41 is provided with many elements which are common in the laminated ceramic capacitor 21 mentioned above, in drawing 2, it gives the same reference mark to the element equivalent to the element shown in drawing 1, and omits the overlapping explanation to it.

[0026]The laminated ceramic capacitor 41 shown in drawing 2 is characterized by providing the trimming schedule portion in relation to each of both sides where the ceramic layered product 25a counters mutually. Namely, it adds to the trimming schedule portion 32 provided in the field to which the comparison electrodes 28-31 formed in the upper surface side of the ceramic layered product 25a counter, Two pairs of comparison electrodes 42 and 43, and 44 and 45 are formed also in the undersurface side of the ceramic layered product 25a, for example, and the trimming schedule portion 47 is formed in the field to which these comparison electrodes 42-45 counter.

[0027]It is in the state which is an inside of the ceramic layered product 25a, makes each edge

counter details mutually and forms capacity in them over the specific interface of the ceramic layer 22 which is below the position in which the internal electrodes 23 and 24 were formed more, Two pairs of comparison electrodes 42 and 43, and 44 and 45 are formed. Therefore, the trimming schedule portion 47 in which removing the ceramic layer 22 selectively in the field to which it compares with the comparison electrodes 42 and 44 which make a pair, and the electrodes 43 and 45 counter was planned is formed in the ceramic layered product 25a.

[0028]The comparison electrodes 42 and 44 are connected to one outer terminal electrode 26, the comparison electrodes 43 and 45 are connected to the outer terminal electrode 27 of another side, and the capacity formed of the comparison electrodes 42-45 mentioned above is taken out with the outer terminal electrodes 26 and 27. Therefore, since it is considered as the value of a request of the capacity as the whole laminated ceramic capacitor 41, in the trimming schedule portion 47, trimming can also be carried out so that the capacity which compares with the comparison electrodes 42 and 44 mentioned above, and is formed among the electrodes 43 and 45 may be decreased.

[0029]According to such a laminated ceramic capacitor 41, trimming operation can be performed also to any of the trimming schedule portions 32 and 47. Therefore, when carrying out trimming, complicated operation of distinguishing the rear surface of the laminated ceramic capacitor 41, or turning the laminated ceramic capacitor 41 in the fixed direction about a rear surface is not needed.

[0030]Trimming operation is performed by the manufacturing stage of the laminated ceramic capacitor 41, or after mounting to the circuit board, are carried out, but. the case where it carries out after mounting -- especially -- it should observe -- even if the laminated ceramic capacitor 41 turns which [ of a rear surface ] side up and is mounted, I hear that trimming can be performed and it is. As mentioned above, although it explained in relation to the laminated ceramic capacitors 21 and 41 illustrating this invention, this invention is applicable to other laminated ceramic electronic components, as long as a capacity component is formed, for example like an LC composite part.

[0031]In the illustrated embodiment, although two pairs of comparison electrodes 28-31, or 42-45 were formed about the one trimming schedule portion 32 or 47, a pair of number of comparison electrodes may be arbitrary, for example, one pair or three pairs or more may be sufficient as it.

[0032]

[Effect of the Invention]Thus, so that capacity may be formed in between [ mutual ] as an inner conductor formed over the specific interface of two or more ceramic layers contained in a ceramic layered product according to this invention, In order to form at least one pair of comparison electrodes arranged in the state where each edge was made to counter mutually, to decrease the capacity formed by the comparison inter-electrode which makes a pair in trimming and to acquire desired capacity value, Removing a ceramic layer selectively from the exterior in the field to which the comparison electrode which makes a pair counters is performed. Therefore, in the trimming mark after this removal, since the section of a comparison electrode is not exposed or the interface of a comparison electrode and a ceramic layer is not exposed, the weatherability of a laminated ceramic electronic component is not degraded with trimming.

[0033]Since a comparison electrode is not removed but a ceramic layer is removed in trimming as mentioned above, a comparison electrode is accidentally divided at the time of trimming, for example, and capacity value is not made to decrease sharply. Therefore, the capacity value by trimming can be

adjusted successful. The spread nature of the metal which constitutes a comparison electrode poses a problem, and does not make fine adjustment of capacity difficult.

[0034]When the trimming schedule portion is provided in the laminated ceramic electronic component concerning this invention in relation to each of both sides where a ceramic layered product counters mutually, trimming operation, Since it can carry out now also to any of a double-sided trimming schedule portion, When carrying out trimming, distinguish the rear surface of a laminated ceramic electronic component, or. Trimming can be performed, even if a laminated ceramic electronic component turns which [ of a rear surface ] side up and is mounted, when carrying out it not only not needing complicated operation of turning a laminated ceramic electronic component in the fixed direction about a rear surface, but after mounting trimming operation.

[0035]If each edge of the comparison electrode which makes each set has aligned in the laminated ceramic electronic component concerning this invention in the laminating direction of the ceramic layered product when it has two or more pairs of comparison electrodes, It can be considered as the shape which either of the comparison electrodes did not rush in into the trimming schedule portion, and was ready in the trimming schedule portion as a result. Therefore, at the time of trimming, it can prevent removing either of the comparison electrodes accidentally, and trimming operation can be made easy.

[0036]In the trimming method of the laminated ceramic electronic component concerning this invention, If the portion located outside the portion pinched between the edges where the comparison electrode in a ceramic layer counters is removed when removing a ceramic layer, It becomes easy to adjust capacity value by a comparatively small span of adjustable range, and if the portion pinched between the edges where the comparison electrode in a ceramic layer counters is removed, it will become easy to adjust capacity value by a comparatively large span of adjustable range.

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[Translation done.]